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AUTHOR Osborn, Julia B.
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ABSTRACT

The Pre-Reading Assessment Inventory (PRAI) was designed to fill a need for a wide-range, individually administered diagnostic test of a child's prereading skills (especially auditory blending and segmenting), knowledge, encoding and decoding strategies, and understandings about the reading task. The test development was based upon the research literature on prereading and early reading, the evaluation of other prereading tests, and two sets of year-long observations of beginning readers by the staff of the Early Decoding and Encoding Strategies Project. After pilot testing and revision, 283 kindergarten children from a variety of socioeconomic and ethnic backgrounds were given the test. Achievement was evaluated one year later when 161 children were given the Gates-MacGinitie Reading test, the Diagnostic Test of Spelling, and the Gray Oral Reading Paragraphs. The PRAI subtest reliabilities were high considering the age of the children and the short length of the subtest. Regression equations yielded multiple correlations between r=.55 and r=.71, though there was a wide range in the correlations between individual subtests and the achievement measures. (Author/FL)

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Children's Prereading Skills and Strategies: Development of an Assessment Inventory*

Julia B. Osborn

Teacher's College, Columbia University

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Abstract

The Pre-Reading Assessment Inventory (PRAI) was designed to fill a need for a wide range, individually administered diagnostic test of a child's pre-reading skills (especially auditory blending and segmenting), knowledges, encoding and decoding strategies and understandings about the reading task. The test development was based upon the research literature on pre- and early reading, the evaluation of other pre-reading tests and two sets of year long observations of beginning readers by the staff of the Early Decoding and Encoding Strategies Project. After pilot testing and revision, 283 kindergarten children from a variety of SES and ethnic backgrounds were tested. Achievement was evaluated one year later when 161 children were given the Gates-MacGinitie Reading Test, the Diagnostic Test of Spelling and the Gray Oral Reading Paragraphs. The PRAI subtest reliabilities, generally above $\alpha = .80$, were high considering the young age of the children and the short length of the subtest. Regression equations yielded multiple correlations between $r = .55$ and $r = .71$, though there was a wide range in the correlations between individual subtests and the achievement measures. The future development of the inventory into two separate but related instruments, one predictive and one diagnostic, was proposed.

Evaluation of a Pre-Reading Assessment Inventory

The large number of currently published tests is an indication that children's readiness for reading instruction has been and continues to be an important concern. But, in most cases, the main purpose of these tests has been predictive rather than diagnostic. Since most existing tests are constructed for group administration, they must, of necessity provide inadequate means for measuring such auditory skills as blending and segmenting, which are important for early reading sucess (Osobrn & Lawrence, Note 1). Although predictive and diagnostic batteries have been developed in the recent past (Calfee, Chapman & Venezky, 1972; deHirsch & Jansky, 1966) each assesses only a limited number of the skills related to later reading achievement. Therefore, the primary goal of this project was to develop a carefully constructed, psychometrically sound instrument that would be useful in evaluating end of kindergarten and beginning of first grade children's understanding of literacy behavior, their pre-reading knowledges and skills and their ability to learn to read and spell new words for which they knew or were taught the necessary phoneme-grapheme correspondences.

A secondary purpose of the test was to extend the current understanding of the relationships between individual children's patterns of pre- reading competencies and their later reading performance. The inclusion of questions about children's understanding of reading, the assessment of their encoding and decoding performance following a teaching sequence and their performance on a series of sight words presented both in isolation and with an auditorily supplied sentence context, would yield rich information for

studying children's strategies in approaching a reading task and would illuminate their relationships with each other and with later reading performance.

Toward these ends, the Pre-Reading Assessment Inventory (PRAI) was constructed on the basis of information from (1) existing research in pre- and beginning reading, (2) a review of group and individual pre-reading tests, (3) data from individual observation and protocals developed by the Early Decoding Strategies Project (Goldberg, Hebard & Rozensher, Note 2) and (4) data derived from a prototype test administered to 46 kindergarten children (Lawrence, Goldberg, Hebard & Osborn, Note 3). A schematic presentation of the test components and the references to the literature which support their inclusion follow. A more complete presentation is included in Osborn and Lawrence (Note 1).

Test Design

Test Components

The PRAI is composed of 37 subtests divided among four areas: (1) auditory and visual skills, (2) knowledges, (3) strategies of encoding and decoding and (4) understandings about reading.

Auditory segmentation tasks. The subtests contained words, syllables and phonemes to be segmented by initial, final, medial and all component parts. The children responded orally.

Evidence suggests that these skills are moderately correlated ($r = .50$) with later reading achievement (Fox & Routh, 1976); that training on these skills leads to improved performance on reading-like tasks (Durrell & Murphy, 1953; Rosner, 1974); that words are easier to segment than syllables which, in turn, are easier to segment than are phonemes (Fox & Routh, 1976; Hardy, Stennet &

Smythe, 1973; Liberman, 1973; Shankweiler, Fischer & Carter, 1974); and that task difficulty varies with the position of the element to be segmented (Rosner, 1974). Correlations between the word and syllable segmentation tasks (r = .67) and between the word and phoneme segmentation tasks (r = .56) indicate that these tasks, while related, are not identical (Fox & Routh, 1976).

Auditory blending tasks. The subtests required children to blend words into phrases, syllables into words and phonemes into words. These three levels of difficulty parallel the three difficulty levels in the segmenting tasks. Children's responses were oral.

Blending ability has been correlated with reading achievement (r = .50 to .64) (Chall, Roswell & Blumenthal, 1963; Hardy, et al., 1973), and has distinquished between advanced and retarded readers (Flynn & Byrne, 1970). Training on it has improved reading performance (Farmer, Nixon & White, 1976; Muller, 1972-73).

Rhyming and initial sound association. In these two production tasks, the child was to give a rhyming word for a VC pattern or to give a word beginning with a specified phoneme.

Rhyme production has been found to be easier than rhyme discrimination and ,also, to be related to other reading readiness predictors (Calfee, et al.,1972). Approximately, 38% of 5 to 5½ year old American children (Calfee, et al., 1972) and 38% of 6 to 7 year old Russian children (Zhurova, 1963) can produce rhymes. Initial sound association, in some ways the reverse of rhyming, was included to test the processes required in rhyming though at a different point within the word.

Visual matching and visual memory. Standards composed of 1,2, 3 or 4 letter strings were presented to the child and were to be matched with one of four simultaneously presented (matching) or sequentially presented (memory) response alternatives.

These subtests allow for assessing orientation and sequence errors, which are minimally related to one another (Liberman, Shankweiler & Orlando, 1971) though sequence errors are more common (Calfee et al., 1972; Lawrence et al., Note 3). Letters were used in order to increase the predictive validity (Barrett, 1966). Although prior research indicates that fewer children perform poorly on visual tasks than on auditory tasks (Calfee et al., 1972; Lawrence et al, Note 3), it is still important to identify those who have problems in visual discrimination, orientation and sequencing.

Letter name and sound production. A complete set of lower case letters was used to test children's production of letter names and sounds.

Letter naming has been found to be predictive of later reading achievement (Gibson & Levin, 1975); letter-sound knowledge has been considered a pre-requisite for "sounding out" (Chall, 1967).

Sight words in isolation and in context. A set of words was selected from two existing tests (Durkin, 1966; Bogatz & Ball, Note 5) and was supplimented by words which were frequently known by children on the screening test developed by the Early Decoding Strategies Project (Lawrence et al., Note 3). These words were presented in isolation and/or in an examiner provided context.

This type of task has been used to indicate the size of a child's sight vocabulary and, in addition, to provide a demonstration of the child's approach to the decoding task. Recent research suggests that children can use either graphic cues, contextual cues or both when they decode unknown words (Biemiller, 1970; Goodman, 1965; Weber, 1970) and that they can decode more words in context than in isolation (Goodman, 1965; Goodman, 1968; Lawrence et al, Note 3).

In order to insure that all children could derive maximum information from the context, each word was presented at the end of a sentence provided orally by the examiner (Miller & Coleman, 1967).

Decoding and encoding. Six letter-sound correspondences (s,m,p,t,a,r) were taught to a criterion of 100%; 10 words were then presented: 5 visually for decoding and 5 auditorily for encoding. Children were instructed in the letter-sound correspondences which they did not know. Those who failed to reach criterion were not given the encoding and decoding tasks.

Though these tasks are not usually part of pre-reading tests their inclusion allows for the assessment of the relative difficulty of each one and can thus shed some light on whether encoding (Goldberg et al., Note 2) or decoding (Venezky, Note 6) develops first. It also permits close analysis of the child's early strategies of encoding and decoding and especially of the overt use of auditory segmenting and blending.

Understandings of the reading task. A wide variety of tasks were constructed to tap, among other things, the child's understanding of the communicative nature of language, the correspondence between written and spoken words and the visual characteristics of print.

A person who can read understands, at least implicitly, the details of the reading process and its varied purposes. There is evidence that suggests that older children have more explicit and detailed concepts about reading than do younger children (Francis, 1973; Myers & Paris, 1978-79). Some studies have found tenuous support for a relationship between understandings and reading achievement (Downing, 1971; Francis, 1973; Johns, 1972) while some have found no evidence to support this relationship (Edwards, 1958; Osborn, Note 7; Muskopf, Note 8). Problems abound in measuring

children's understanding and this section is necessarily exploratory.

Test development. Items were written for each component and were pilot tested on 46 kindergarten children representing a range of SES and ethnic backgounds. Revisions of the items and instructions were made and a new draft of the PRAI was constructed.

Field Testing

Reliability Testing

Subjects. The test was given to 283 children (135 boys and 148 girls) with a mean age of 70.2 months (range 59 to 84 months) and a mean vocabulary scaled score on the WPPSI (Weschler, 1967) of 9.3 (S.D. = 2.8) which was somewhat lower than that reported for a WPPSI reliability test sample ($\bar{x}$ = 10.8, S.D. = 3.5). The children came from 18 schools in New York City and represented a variety of ethnic groups: Caucasion (n = 156), Hispanic (n = 62), Black (n = 38), Oriental (n = 11) and other (n = 12). While most of the children were monolingual (n = 195), some were bilingual in Spanish (n = 56) or in another language (n = 32). Though there was no individual measure of socio-economic background, the schools represented a wide variety: 7 public schools were drawn from one of New York City's most economically diverse districts, 3 were lower and working class day care centers, 4 were lower middle class parochial schools and 4 were high tuition private schools.

Administration and scoring. In order to shorten administration time, the test was divided into 4 sections, every combination of 2 sections was included in one of six forms. Equal numbers of each form were assigned to each school but the assignment of child to form was random. Each child was seen for two half hour sessions, each time by a different examiner. The testing was completed by six trained examiners, in nine weeks between March and June, 1978.

Validity Testing

Subjects. Over half of the original sample, 161 children (74 boys and 87 girls) were located at the end of first grade. The group of children who were located did not differ from the other group of children on mean age, mean vocabulary score, proportion of boys to girls or on proportions of ethnic groups. However, a slightly higher proportion of monolingual English speakers (75.2% versus 60%) and a concomitantly lower proportion of Spanish speaking bilingual children (14% versus 27%) were in this group. Of the 37 t-tests for differences between the two groups on mean performance on the PRAI subtests, only 5 were significant. They were: component word segmentation, identification of literacy behavior, medial phoneme segmentation, word recognition and general questions. The first two subtests were not significantly correlated with reading achievement; the last three were. The differences favored this group and they may be related to the higher proportion of monolingual English speakers.

Test administration and scoring. The Gates-MacGinitie Reading Test, primary A form 1, 1978 revision was given to small groups of children on two separate sessions. The vocabulary test was given on one day and the comprehension on another day, usually a week later. In a subsequent individual session, each child was given, first, the Diagnostic Test of Spelling (DTS) forms A and B (Gnagey, 1976), second, the Gray Oral Reading Paragraphs, form A (Robinson and Gray, 1963) and last, four subtests from the PRAI: (1) component syllable segmentation, (2) component phoneme segmentation, (3) syllable blending and (4) phoneme blending.

The administration and scoring proceedures followed the forms specified in the test manuals. The testing was completed by 5 trained testers in 8 weeks between April and June, 1979.

Table 1

Means, Standard Deviations, Medians and Average Percents of Responses Correct for Thirty-four Subtests of the PRAI[a]

	n	Possible score	M	SD	Mdn	% of correct responses	K-R α
Initial segmentation							
Word	145	6	5.4	1.3	5.3	90	.83
Syllable	145	8	6.5	2.1	6.8	81	.83
Phoneme	145	8	5.0	2.6	5.0	63	.82
Medial segmentation							
Word	140	6	3.7	2.1	3.9	62	.83
Syllable	140	8	2.3	2.8	.6	29	.91
Phoneme	140	8	1.2	2.0	.4	15	.84
Final segmentation							
Word	140	6	5.0	1.6	5.1	83	.83
Syllable	140	8	4.0	2.8	3.0	50	.88
Phoneme	140	8	2.3	2.7	.4	29	.89
Component segmentation							
Word	141	12	10.0	3.7	10.4	83	.86
Syllable	141	19	14.2	6.0	15.9	75	.90
Phoneme	141	24	7.6	7.1	5.9	32	.86
Blending							
Word	145	6	5.6	1.1	5.4	93	.84
Syllable	145	10	8.6	2.3	9.1	86	.85
Phoneme	145	18	8.9	4.7	7.7	49	.89
Rhyming	140	8	4.8	3.2	5.5	60	.93
Initial sound association	141	8	5.8	2.7	6.5	73	.89
Visual matching	140	12	8.1	2.5	8.6	73	.75
Visual memory	141	12	7.4	2.6	7.0	62	.68
Letter name production	145	26	20.0	5.8	21.3	77	.92
Letter sound production	145	26	12.0	8.1	11.9	46	.95
Sight words	140	17	4.0	5.0	2.3	24	.94
Words in context	141	17	8.1	5.2	7.6	48	.91
Phoneme recognition	140	6	4.3	1.9	4.6	72	.77
Encoding	100	28	20.0	8.1	21.2	71	.91
Decoding	100	28	16.6	10.4	17.5	59	.90
General questions	145	16	10.8	3.4	10.4	68	.58
Ident. of lit. beh.	140	5	2.7	1.3	2.1	54	
Ident. of read. mat.	140	6	4.9	1.3	4.7	81	.53
Communicative nat. of lang.	140	1	.7	.5	.3	70	
Number-letter distinction	145	3	2.0	1.0	1.7	67	.54
Reading terminology	140	9	5.0	2.0	4.5	56	.71
Sounds to be written	141	9	5.5	1.8	5.0	64	.36
Definition of a word	141	13	8.6	3.0	8.7	66	.77

[a]The three subtests of the teaching sequence are not included.

Results

A preliminary analysis revealed that there were only 3 (of 37 possible) comparisons in which performance on a given subtest in any one form differed significantly from performance on the same subtest in a different form. Consequently, all identical subtest analyses were performed on data collapsed across forms, yielding sample sizes of from 140 to 145 children. Comparison of performance among subtests was performed on sample sizes ranging from 44 to 50 (see Table 2 for exact sample sizes).

Reliability. The reliabilities of all the subtests were computed by the Kuder-Richardson Formula 20 (see Table 1). In the auditory skills, the reliabilities were high (α = .82 to α = .93); for the visual skills they were lower (matching α = .75, memory α = .68). With the exception of the phoneme recognition subtest (α = .77), the reliabilities for the knowledge subtests (letter name and sound production, words in isolation and words in context) were all α = .91 or higher. The reliabilities for the encoding and the decoding tasks were also high (α = .91 and α = .90, respectively), while those for the understandings subtests were considerably lower (α = .36 to α = .77). In general, the reliabilities were gratifyingly high, especially considering the limited length of the subtests and the young age of the children who were tested.

Correlations Among Subtests Within Areas

Correlations among skills subtests. An intercorrelational matrix of all subtests was generated (see Table 2). It revealed moderate correlations among the auditory segmentation tasks (r = .30 to r = .71), among the auditory blending tasks (r = ,32 to r = .46), among all the auditory tasks (r = -.08 to r = .69), between the two visual subtests (r = .57) and among all the skills subtests (r = -.08 to r = .71).

Table 2

Intercorrelations Among All Subtests

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1. Age																																									
2. Sex	[illegible][b]																																									
3. Bilingual	01[b]	02[b]																																								
4. Ethnicity	-07[b]	-07[b]	60[b]																																							
5. Teach. Judgment	01[b]	-09[b]	22[b]	03[b]																																						
6. Vocabulary	-24[b]	05[b]	-37[b]	-37[b]	16[b]																																					
7. Im. Word Seq.	18[a]	08[a]	-04[a]	-16[a]	07[a]	18[a]																																				
8. Im. Syll. Seq.	01[a]	10[a]	-05[a]	01[a]	17[a]	28[a]	56[a]																																			
9. Im. Phon. Seq.	17[a]	05[a]	-15[a]	-18[a]	03[a]	33[a]	47[a]	49[a]																																		
10. Fl. Word Seq.	21[a]	01[a]	-09[a]	-24[a]	09[a]	17[a]	28	14	21																																	
11. Fl. Syll. Seq.	25[a]	00[a]	-10[a]	-20[a]	13[a]	21[a]	41	20	40	34[a]																																
12. Fl. Phon. Seq.	15[a]	09[a]	-10[a]	-14[a]	10[a]	26[a]	30	17	33	30[a]	38[a]																															
13. Me. Word Seq.	18[a]	-08[a]	19[a]	-21[a]	19[a]	32[a]	54	44	32	56	64	49																														
14. Me. Syll. Seq.	14[a]	-09[a]	-01[a]	-06[a]	11[a]	23[a]	26	28	25	30	37	32	47[a]																													
15. Me. Phon. Seq.	11[a]	-03[a]	-05[a]	-13[a]	19[a]	27[a]	17	22	31	26	45	48	40[a]	55[a]																												
16. Comp. Word Seq.	-15[a]	-08[a]	-14[a]	-16[a]	13[a]	40[a]	32	48	37	38	47	16	44	23	31																											
17. Comp. Syll. Seq.	-04[a]	-05[a]	-10[a]	-11[a]	07[a]	37[a]	32	43	43	28	41	31	44	49	34	71[a]																										
18. Comp. Phon. Seq.	17[a]	03[a]	-10[a]	-21[a]	20[a]	39[a]	31	33	50	32	62	48	60	34	65	38[a]	43[a]																									
19. Word Bland.	09[a]	-08[a]	-01[a]	-02[a]	08[a]	19[a]	18[a]	37[a]	32[a]	06	12	-08	25	17	16	46	07	13																								
20. Syll. Bland.	08[a]	-06[a]	-12[a]	-03[a]	16[a]	43[a]	42[a]	52[a]	56[a]	06	33	36	25	20	28	39	35	20	45[a]																						
21. Phon. Bland.	03[a]	-03[a]	-01[a]	-07[a]	13[a]	32[a]	28[a]	29[a]	42	14	40	41	30	38	52	18	12	40	32[a]	46[a]																					
22. Rhyming	06[a]	-09[a]	-34[a]	-30[a]	12[a]	41[a]	28	36	30	19	27	29	38[a]	28[a]	38[a]	35	44	50	21	37	22																				
23. Im. Sod. Assoc.	08[a]	-03[a]	-29[a]	-29[a]	12[a]	38[a]	43	40	66	40	48	37	66	45	47	40	33[a]	55[a]	-11	30	33	69																		
24. Vis. Match	25[a]	-02[a]	-08[a]	-22[a]	31[a]	32[a]	35	47	61	48[a]	41[a]	27[a]	44	19	33	31[a]	40	48	09	30	44	28	49																	
25. Vis. Memory	06[a]	-06[a]	-12[a]	-07[a]	10[a]	17[a]	37	39	39	41	34	34	18	17	23	34[a]	29[a]	44[a]	01	34	31	46	43[a]	51																
26. Num. Let. Det.	-13[a]	-12[a]	-32[a]	-31[a]	09[a]	44[a]	34[a]	39[a]	45[a]	22	39	12	32	16	17	38	31	28	23[a]	44[a]	20[a]	31	29	36	40																
27. Letter Sound	04[a]	-10[a]	-25[a]	-19[a]	28[a]	38[a]	37[a]	33[a]	54[a]	37	33	40	34	40	42	17	33	43	16[a]	38[a]	41[a]	45	53	47	48	42[a]														
28. Letter Name	07[a]	-11[a]	-25[a]	-27[a]	20[a]	45[a]	40[a]	31[a]	67[a]	27	46	50	53	40	54	33	41	58	23[a]	48[a]	54[a]	44	64	48	59	46[a]	78[a]													
29. Word Recog.	-09[a]	02[a]	-19[a]	-15[a]	35[a]	36[a]	25	33	27	32	40	58	43[a]	38[a]	60[a]	43	44	61	25	27	65	42[a]	62	46	42	20	54	56												
30. Words in Context	00[a]	05[a]	-30[a]	-17[a]	34[a]	41[a]	27	42	52	39	37	37	58	50	65	35[a]	24[a]	46[a]	-06	32	48	49	59	34	44[a]	43	58	68	82											
31. Gen'l Questions	12[a]	-01[a]	-10[a]	-21[a]	21[a]	35[a]	32[a]	27[a]	30[a]	14	19	05	08	11	31	32	43	45	11[a]	24[a]	16[a]	09	28	32	17	37[a]	42[a]	35[a]	16	22										
32. Reading Term.	14[a]	-03[a]	-16[a]	-16[a]	23[a]	29[a]	18	05	34	30[a]	28[a]	26[a]	44	19	40	43	30	28	-14	24	13	42	27	39[a]	39	35	41	48	44	48	09									
33. Id. Lit. Beh.	02[a]	-21[a]	-01[a]	-09[a]	08[a]	14[a]	03	25	-06	23	07	16	11[a]	25[a]	28[a]	45	46	33	10	22	04	15[a]	42	10	32	03	10	13	22[a]	29	12	23								
34. Comm. Nat. Lang.	14[a]	-15[a]	-01[a]	-10[a]	-11[a]	18[a]	14	21	19	42	08	14	26[a]	18[a]	11[a]	50	40	39	28	17	-07	16[a]	48	29	16	08	-12	09	07[a]	36	17	21	16[a]							
35. Id. Read. Mat.	07[a]	-16[a]	-22[a]	-19[a]	05[a]	26[a]	25	13	23	14	04	22	21[a]	09[a]	08[a]	25	26	22	18	04	28	28[a]	15	01	02	03	46	34	17[a]	15	10	25	02[a]	12[a]						
36. Snd. to be Written	04[a]	07[a]	-18[a]	-24[a]	04[a]	21[a]	11	17	24	08	21	34	25	33	23	09[a]	07[a]	19[a]	02	26	29	12	11[a]	-07	-01[a]	39	15	28	27	25[a]	37	15	06[a]	17[a]	29[a]					
37. Def. of Word	03[a]	01[a]	-11[a]	-14[a]	03[a]	28[a]	28	24	38	29	13	-02	04	24	47	18[a]	09[a]	14[a]	-02	34	34	10	21[a]	29	17[a]	22	23	23	35	34[a]	10	27	14	33	17	09[a]				
38. Phoneme Recog.	14[a]	-04[a]	-24[a]	-36[a]	30[a]	48[a]	39	32	68	36[a]	47[a]	51[a]	43	25	30	49	39	61	37	49	52	35	54	51[a]	51	47	76	79	42	67	25	41[a]	02	08	20	16	20			
39. Let. Name Bf. Inst.	09[a]	-12[a]	-24[a]	-28[a]	27[a]	38[a]	33	23	59	36[a]	36[a]	45[a]	38	20	32	49	42	48	01	43	41	44	38	52[a]	40	22	84	73	58	54	33	36[a]	11	15	08	15	13	66[a]		
40. Let. Snd. Bf. Inst.	12[a]	-11[a]	-29[a]	-23[a]	27[a]	52[a]	34	30	68	31[a]	38[a]	52[a]	41	14	38	53	43	49	17	30	46	44	35	49[a]	46	41	76	85	61	76	26	42[a]	23	20	12	[illegible]	15	78[a]	73[a]	
41. Let. Snd. Af. Inst.	17[a]	-09[a]	-27[a]	-24[a]	26[a]	54[a]	41	42	72	37[a]	43[a]	50[a]	57	24	40	50	44	58	17	57	39	32	46	55[a]	45	47	84	84	60	75	33	43[a]	23	37	09	[illegible]	18	77[a]	73[a]	91[a]	
42. Encoding	13[a]	-11[a]	-02[a]	-06[a]	14[a]	14[a]	30	00	43	30[a]	49[a]	53[a]	35	00	46	-05	15	70	19	29	55	41	71	32[a]	46	-08	61	82	67	33	-12	23[a]	21	-16	41	24	21	48[a]	40[a]	55[a]	62[a]	
43. Decoding	-00[a]	-08[a]	-02[a]	-03[a]	01[a]	21[a]	22	20	16	21[a]	27[a]	48[a]	14	08	52	07	14	55	18	25	62	37	47	17[a]	31	-19	50	52	73	49	-05	14[a]	35	09	49	35	18	31[a]	34[a]	48[a]	50[a]	68[a]

Unless otherwise noted, correlations are based on 44 to 50 responses; decimal points have been deleted.

[a]These correlations are based on responses from 139 to 145 children.

[b]These correlations are based on responses from 383 children.

12a

12b

The two tasks that correlated best with all the other skills tasks were component syllable segmentation (r = .07 to r = .71) and component phoneme segmentation (r = .13 to r = .68). The correlations within the skills area show that these subtests meet Calfee's criterion (Note 9) that the subtests in a screening test measure independent skills which are only modestly correlated with one another.

Though rhyming and initial sound association were designed to tap the same auditory processes, rhyming did not correlate significantly with final syllable segmentation (r = .27) but initial sound association did correlate significantly with initial syllable segmentation (r = .66). In rhyming, the child was not required to do any segmentation as the examiner provided the segmented element to be used in constructing the new word. In other tests when children have been asked to produce rhyming words and the examiner has not segmented the final phonemes for them, their performance in rhyming has correlated with their performance in segmenting (r = .54, Calfee et al., 1972).

Correlations among knowledge subtests. The correlations within the knowledge area were stronger than those within the skills area: letter name production correlated r = .73 with letter sound production and sight word recognition correlated r = .82 with words in context. These correlations may partly be the result of using the same sets of stimuli in the two pairs of tests. It was clear that if a letter sound was known then the name for that letter was also known. Similarly, if a word was read in isolation then it was also read in context. The reverse was true in .5% of the cases.

Correlations among encoding and decoding subtests. In this area, the correlation between letter sounds known before and after instruction (r = .91) indicated that the more letter-sounds a child knew before

instruction the more he knew after instruction. Children who knew 2 or fewer phonemes before instruction had, at most, a 43% chance of knowing all 6 after instruction; children who knew 4 or more phonemes before instruction invariably knew all 6 after instruction. This may have been due to the short (10 minute) instructional period. Encoding was easier ($\bar{x}$ = 20.0) than decoding ($\bar{x}$ = 16.0).

Correlations among the understandings subtests. The subtests in the understandings area had lower correlations than did the subtests in the other areas; 19 of the 21 correlations were below r = .30. One reason for the low intercorrelations may be the low reliabilities of these subtests. However, it is also possible that they tapped different and essentially unrelated understandings.

Correlations Among Subtests Across Areas

Inspection of the intercorrelational matrix (see Table 2) indicates that while there were significant relationships among subtests across the four areas (skills, knowledge, encoding-decoding, and beliefs) they were generally lower than those found among subtests within areas. However, there were some subtests that were consistently related to almost all the other subtests (e.g. letter name knowledge) while some subtests were less often related to other subtests (e.g. sounds to be written).

Correlations between the skills and knowledge areas. All but one of the auditory tasks correlated significantly with letter name knowledge (r = .25 to r = .67) and all but one correlated significantly with letter sound knowledge (r = .16 to r = .54). Approximately three quarters (27 of 34) of the correlations between auditory skills and word knowledge subtests were significant (r = -.06 to r = .65).

The strongest correlations between individual subtests were:

initial phoneme segmentation with letter name and sound (r = .67 and r = .54, respectively) and initial sound association with letter name production and with word recognition (r = .64 and r = .62, respectively). As mentioned previously, initial phoneme segmentation and initial sound association had a correlation of similar magnitude (r = .66). Perhaps all of these subtests are related in that they tap information reflecting specific school instruction.

The correlations between the visual skills and knowledges were slightly lower that those between the auditory skills and knowledges, though all of them were significant.(r = .42 to r = .59). It is quite likely that those children who knew letter name correspondences had information which enabled them to be more accurate on the matching tasks and especially on the memory tasks. On this later task, a number of children were observed who rehearsed aloud the names of the letter strings that they were trying to remember.

Correlations between the skills and encoding-decoding. Most of the word and syllable level auditory skills correlated more weakly with encoding (r = .00 to r = .49) than did the phoneme level skills (r = .43 to r = .70). Only half of the former correlations were significant, while all of later were significant. Word and syllable level skills had insignificant correlations with decoding (r = .08 to r = .27), however, four of the five correlations between phoneme level skills and decoding were significant (r= .16 to r = .62). This, again, supports the hypothesis that phoneme level processing may be more important to beginning reading than syllable or word level processing. Of all the phoneme level segmentation tasks, component phoneme segmentation correlated most strongly with encoding and with decoding (r = .70 and r = .50, respectively).

The correlations between rhyming and initial sound association and encoding-decoding were in the middle of the range for the correlations between the skills and encoding-decoding ($r = .37$ to $r = .47$). The exception was initial sound association which, of all the auditory skills, had the strongest correlation with encoding ($r = .71$). This may have been due partly to their common correlation with letter sound and name production.

Two other of the stronger correlations are of particular interest: encoding with component phoneme segmentation ($r = .70$) and decoding with phoneme blending ($r = .62$). These significant correlations coincide with a logical analysis of each tasks' requirements. When a child wishes to encode, he/she must first break the spoken word down into its phonemic units before choosing the appropriate letters. In decoding, the reverse is true; before the child can produce the correct word, the phonemic correspondences of the letters need to be blended together.

In general, the visual skills correlated less strongly with encoding and decoding ($r = .17$ to $r = .46$) than did the auditory skills; though all of them were significant. It may be that minimal competance on the visual skills is necessary for adequate encoding and decoding though increasingly better performance on the visual skills will not result in increasingly better performance on encoding and decoding.

Correlations between knowledges and encoding-decoding. The intercorrelations between these two areas were stronger than the intercorrelations between any other two areas. Letter knowledges correlated more strongly with encoding-decoding ($r = .50$ to $r = .82$)

than did word knowledges (r = .33 to r = .73) but all of them were significant. However, the two strongest correlations were letter name knowledge with encoding (r = .82) and word recognition with decoding (r = .73). The later correlation suggests that some children who were already reading were able to do well on the word recognition and on the decoding task.

Also of interest, the letter name and sound production tasks correlated better with encoding (r = .82 and r = .61, respectively) and with decoding (r = .52 and r = .50, respectively) than did phoneme recognition (r = .48 with encoding, r = .31 with decoding). This may be due to the greater ease of the recognition task; only 5 % of the letter-sound correspondences were produced and not recognized. It suggests, however, that letter recognition tasks used in most group tests may not be as informative as individually administered letter name and sound production tasks.

Correlations between skills and understandings. The correlations between these two areas were generally lower than those between skills and knowledge or between skills and encoding-decoding; only one quarter of them were significant. Auditory skills and understandings (r = -.14 to r = .45) had approximately the same range of correlations as visual skills and understandings (r = -.07 to r = .39).

Correlations between knowledge and understandings. The correlations between these two areas were of the same range as were the correlations between skills and understandings, although, almost half of them were significant. Letter knowledge correlated with the understandings subtests (r = .07 to r = .44) and word knowledges correlated with understandings (r = .15 to r = .48). Of all the understandings subtests, reading terminology showed the strongest

correlations with the knowledges (r = .41 to r = .48). This seems logical considering that sucess on reading terminology (identifying letters, words and sentences) implies an exposure to reading materials.

Correlations between encoding-decoding and understandings. The range of the correlations between the understandings subtests and the encoding (r = -.16 to r = .41) and decoding (r = -.05 to r = .49) was similar to the range of correlations found between the understandings area and the other areas. One third of these are significant. Of all the understandings subtests the one which correlated most strongly with encoding and decoding was the identification of readable material (r = .41 and r = .49).

Summary of correlations across areas. With a few exceptions, the following general relationships were found between the subtests in the different areas. The understandings subtests correlated minimally with the other areas, whereas, the skills area subtests correlated much better with the encoding-decoding area and with the knowledge area. The two areas that correlated best were encoding-decoding and knowledge.

Correlations Among Achievement Measures and Concurrent PRAI Subtests

An intercorrelation matrix was generated with correlations among all the achievement measures and the PRAI subtests. As expected, the three achievement tests correlated strongly with each other (r = .70 to r = .97). The highest correlations were between parts of the same tests, the next highest correlations were between the Gates-MacGinitie and the Gray (r = .84 to r = .86). The two reading measures correlated slightly less well with the DTS (r = .71 to r = .80).

All the PRAI subtests were significantly related to the achievement measures, however, phoneme blending (r = .47) and syllable blending (r = .36) correlated more strongly than the component pho-

neme segmentation (r = .25) or the component syllable segmentation (r = . 27). Note that on the four PRAI subtests the mean performance was higher for the first graders and the variability was was less than either had been for the kindergarteners. For the first graders the means and standard deviations were: component syllable segmentation ($\bar{x}$ = 18.16, S.D. = 2.02), component phoneme segmentation ($\bar{x}$ = 16.56, S.D. = .5), syllable blending ($\bar{x}$ = 9.32, S.D. = .12) and phoneme blending ($\bar{x}$ = 14.57, S.D. = .31). The means are close to the maximum scores indicating that many of the first graders were proficient at these tasks.

Correlations Between Kindergarten PRAI Scores and Achievement

Pearson correlations between all the PRAI subtests and the achievement tests were computed. When the partial correlations, which controlled for the effect of vocabulary score, were compared with them it was clear that vocabulary knowledge had little effect on the correlations. The partial correlations were generally .04 lower that the Pearson correlations though the range of difference between the two was from .01 to .07. General mental ability, as measured by the ability to verbally define words, accounts for little of the variance between the PRAI subtests and the achievement measures.

Auditory and visual skills. All of the correlations between the word level segmentation tasks and the achievement measures were low (r = .05 to r = .23; Table 3). The average correlations with the syllable level tasks were better (r = .10 to r = .30); final syllable segmentation was the best of these. The strongest correlations were with the phoneme level tasks (r = .32 to r = .53). The two best were medial phoneme (r = .53) and component phoneme segmentation (r = .53).

In the blending tasks the correlations with achievement also

Table 3

Correlations Between PRAI Subtests and Achievement Tests

with Vocabulary Score Partialled Out

		Achievement measure			
PRAI subtest	n	G.+MacG.	DTS	Gray	Average
In. Word Seg.	82	.22	.21	.21	.21
In. Syll. Seg	82	.25	.26	.16	.22
In. Phon. Seg.	82	.32	.34	.30	.32
Fi. Word Seg.	74	.17	.19	.15	.17
Fi. Syll. Seg.	74	.28	.32	.29	.30
Fi. Phon. Seg.	74	.33	.32	.40	.35
Me. Word Seg.	73	.32	.16	.22	.23
Me. Syll. Seg.	73	.27	.06	.06	.13
Me. Phon. Seg.	73	.52	.53	.54	.53
Comp. Word Seg.	73	.02	.10	.06	.06
Comp. Syll Seg.	73	.06	.12	.14	.10
Comp. Phon. Seg.	73	.52	.51	.58	.53
Word Blend.	82	-.03	.01	-.02	-.02
Syll. Blend.	82	.20	.24	.27	.23
Phon. Blend.	82	.47	.38	.43	.43
Rhyming	73	.24	.12	.30	.22
In. Snd. Assoc.	73	.37	.34	.41	.37
Vis. Match.	74	.33	.32	.40	.32
Vis. Memory	73	.45	.41	.48	.44
Num. Let. Dst.	82	.09	.10	.13	.11
Letter Sound	82	.50	.48	.48	.49
Letter Name	82	.52	.47	.47	.49
Word Recog.	73	.58	.31	.47	.45
Words in Context	73	.54	.39	.48	.47
Gen'l Questions	82	.24	.33	.30	.29
Reading Term.	74	-.01	-.01	.07	.02
Id. Lit. Beh.	73	.02	-.01	.06	.03
Comm. Nat. Lang.	73	-.03	-.01	-.02	-.02
Id. Read. Mat.	73	.10	.01	.01	.04
Snd. to be Written	73	.03	-.10	-.02	-.03
Def. of Word	73	.02	-.04	-.03	-.02
Phoneme Recog.	74	.33	.34	.41	.36
Let. Name Bf. Inst.	74	.40	.48	.45	.44
Let. Snd. Bf. Inst.	74	.53	.45	.56	.51
Let Snd. Af. Inst.	74	.52	.49	.59	.53
Encoding	57	.42	.32	.47	.40
Decoding	57	.45	.36	.51	.44

increased from word level (r = -.02) to syllable level (r = .23) and to phoneme level (r = .43). Note that though syllable and phoneme blending were easier tasks for first graders, they correlated more highly with first grade reading when measured in first grade (r = .36 and r = .46, respectively).

Rhyming and initial sound association had low though significant correlations with achievement (r = .22 and r = .37, respectively).

The visual matching and the visual memory task correlated significantly with achievement (r = .32 and r = .44, respectively) though not as well as the auditory skills did. Because of their high correlation with each other it may be possible to use one or the other in a revised assessment instrument.

Knowledges. These subtests had some of the stronger correlations with reading achievement though not the strongest. Letter name and sound production had identical average correlations with achievement (r = .49) but word recognition (r = .45) and words in context (r = .47) were slightly lower. The order of magnitude of these correlations paralleled that of the correlations between knowledges and encoding-decoding, with one exception. Words in context correlated slightly better with the achievement measures, probably because these tests also required reading in context.

Encoding and Decoding. These two subtests correlated significantly with reading achievement (r = .40 and r = .44, respectively). The similarity of the correlation between skills, knowledges and encoding-decoding one one hand and between skills, knowledges and reading achievement on the other, suggest that the encoding and decoding subtests are valid quasi spelling and reading tasks.

The significant correlations of letter sounds known before instruction (r = .51) and letter names before instruction (r = .44)

with achievement suggests that the letter name and sound production tasks may be shortened to just 6 letters (m,s,p,r,t,a) without much loss of predictive validity.

Understandings. All but one of the correlations between understandings subtests and achievement were insignificant; that one, general questions (r = .29) was not strong. This combined with the low reliabilities of these subtests makes it unlikely that they would be useful in future versions of the assessment inventory.

Regression Analyses

The correlations between the individual subtests and achievement are informative, however, they do not indicate to what extent the different subtests are explaining common portions of the variance in achievement. Regression equations can yield this information and are thereby useful in selecting subtests for inclusion in a revised instrument.

When the test was constructed, the subtests were assigned to different quarters and then each child was tested on two quarters. Consequently, stepwise regression equations were calculated for the achievement measures based upon the subtests within each separate quarter. For each quarter there were scores for approximately 80 children (Table 4).

Quarter A. For all three regression equations, (one each for the Gates-MacGinitie, the DTS and the Gray), four subtests explain most of the variance in performance. They are: letter name production, phoneme blending, general questions and letter sound production. After these four subtests, various others explain .01 additional variance for each of these two achievement tests: initial syllable segmentation for the Gates and initial phoneme segmentation and initial

Table 4

Multiple Correlation Coefficients and Subtest Lists for Each PRAI Quarter[1]

Quarter	Subtests	Multiple Correlation Coefficient		
		Gates-MacGinitie	DTS	Gray
A	*Letter Name *Phone. Blend *Gen'l Questions *Word Blend. Letter Sound In. Syll. Seg. In. Phon. Seg. Num. Let. Dst. In. Word Seg. Syll Blend.	.66	.56	.58
B	*Let. Name Bf. Inst./ Let. Snd. Bf. Inst./ Let. Snd. Af. Inst.[1] *Decoding *Fi. Syll. Seg. *Read. Term *Vis. Match Fi. Word Seg. Phoneme Recog. Fi. Phon. Seg. Encoding	.66	.63	.69
C	*Med. Phon. Seg. *Med. Syll. Seg. *Word Recog. *Id. of Lit. Beh. Rhyming Med. Word Seg. Id. Read. Mat. Comm. Nat. Lang.	.65	.58	.61
D	*Comp. Phon. Seg. *Vis. Memory *Words in Context *Def. Word Comp. Word Seg. In. Snd. Assoc. Comp. Syll. Seg. Snd. to be Written	.71	.60	.70

* These subtests contribute to the coefficients reported for their quarter.

1 Each of these subtests appeared first in one of the three regression equations. They are highly intercorrelated and can probably substitute for one another.

syllable segmentation for the DTS. The predictiveness of letter name knowledge has been well documented but note that phoneme blending adds predictiveness to this variable. That initial phoneme segmentation does not contribute to the regression equation can be explained by its strong correlation with letter name and sound production.

Quarter B. The first variable entered into the three regression equations differed for each of the achievement tests. For the Gates-MacGinitie it was letter sounds known before instruction, for the DTS it was letter names known before instruction and for the Gray it was letter sounds known after instruction. These three subtests were all so highly intercorrelated, especially letter sounds before and after instruction (r = .91), that it is likely that if two were removed from administration in the quarter that the remaining subtest would be the first one in the regression equations for all three tests. In all the equations, decoding was the second variable entered, followed by final syllable segmentation, reading terminology and visual matching. Note again that though a measure of letter knowledge is the most predictive measure in the quarter it is augmented by a subtest unique to the PRAI.

Quarter C. Medial phoneme segmentation was the first variable entered into the regression equations for the DTS and for the Gray. It was followed by medial syllable segmentation. For the DTS, identification of literacy behavior completed the equation; for the Gray, word recognition and rhyming completed it. The regression equation for the Gates differed from the other two equations; the order of variables was word recognition, medial phoneme segmentation and identification of literacy behavior. Note that while the understanding subtest, identification of literacy behavior, did not correlate significantly with the achievement measures, it did add a small (.01) amount

to the explained variance in the achievement scores. Skill in segmenting medial phonemes and medial syllables appears to be well related to sucess in reading.

Quarter D. For the DTS and the Gray, the first four subtests which entered into the regression equations were component phoneme segmentation, visual memory, words in context and definition of a word. For the Gates, the first four were: words in context, component phoneme segmentation, component word segmentation and visual memory. In addition, the understandings subtest, sounds to be written, added .01 to the explained variance for each test. Note that, again, the phoneme segmentation task appears to be pivotal in predicting later reading and spelling achievement. Furthermore, this skill is different enough from visual memory and words in context that these subtests together add .07 to .10 to the explained variance of the achievement tests.

Summary. Twelve separate regression equations were calculated, one for each of the three achievement measures in each of the four quarters of the inventory. The multiple correlations were quite good; they ranged from r = .56 to r = .71. If all of the subtests were given to each child, it would be possible to compare the relative predictiveness of the stronger predictors from each quarter. A regression equation encompassing these subtests might yield a regression correlation higher than any currently found. This is an important next step for the development of the inventory.

Discussion

Reliability and Validity of the PRAI

Auditory and visual skills. The skills tests, particularly in the auditory area, were included on the basis of research literature which suggested that these skills were essential for and correlated with

reading sucess. The subtests were highly reliable though they varied in their predictive validity. As individual subtests, the strongest correlations for both blending and segmenting were obtained from the phoneme level tasks, next strongest were the correlations from the syllable level tasks, the weakest were from the word level tasks. This ordering was not reflected in the regression equations as syllable and word level tasks did enter into the equations and some phoneme level tasks did not. However, two phoneme level tests were the first variables to be entered into the regression equations for their test quarters.

The other auditory skills, rhyming and initial sound association, and also the visual skills were reliable though the visual skills were more predictive of later sucess.

Knowledges. The knowledge subtests were included in this inventory as they have a well documented ability to predict reading achievement and could be used as a standard by which to judge the predictiveness of the other subtests. As expected, these subtests were both reliable and predictive. All the subtests in this area entered into the regression equations; letter name knowledge was the best predictor for its quarter.

Encoding and decoding. Both of these novel subtests were reliably administered and scored and also had good individual correlations with reading achievement. However, in the regression equations, decoding was entered first and encoding did not account for any additional variance. Both tasks yielded rich process information.

Understandings. None of these subtests, with the exception of general questions, correlated significantly with reading achievement. They do occasionally explain some additional variance in the regression equations. In spite of this, their low reliabilities and inter-

correlations suggest that it is not profitable to continue using these subtests in their present form.

Predictive and Diagnostic Tests from the PRAI

The test design and evaluation was planned with two goals, one, to create a maximally predictive instrument and, two, to creat a diagnostic instrument. These two goals imply different criteria for selecting subtests and may eventually imply different administration proceedures also. A predictive measure is best if it is short, easily scored and administered to groups. Subtests should be chosen for ease and brevity of administration and for maximal predictiveness. A simple score of numbers of items correct yields sufficient information. On the other hand, a diagnostic instrument may be longer, should be individually administered and must yield detailed performance information relevant to instructional and remedial techniques. Subtests should be chosen to tap skills, knowledges and processes that are essential to reading and spelling performance and that are also amenable to instruction.

Knowledges. For predictive purposes, the two best subtests are: letter name production, because of its importance in the regression equation and word recognition, because of its ease of administration. Letter name production perhaps could be shortened to the six letters (s,m,p,t,r,a) used in the decoding and encoding tasks. Little predictive validity would be lost and much administration time would be saved.

For diagnostic purposes, letter sound production (especially considering its high correlation with concurrently measured encoding) and reading words in context would be best. The later subtest would allow the examiner to assess the child's use of context in decoding unknown words as well as the use of sounding out strategies. A

comparison of the letter sounds known and the letter sounds used in decoding could provide further diagnostic information.

Auditory and visual skills. The difficulty level of the auditory task administered may best be determined by the testing purpose. For maximal predictiveness, component phoneme segmentation, medial phoneme segmentation and phoneme blending are best. In fact one or more of these may be as predictive as letter name knowledge. However, these are the most difficult tasks and the poorer pre-readers do not respond correctly to the items. It is impossible to know if their poor performance results from a lack of skill or a poor understanding of the test directions.

Consequently, for diagnostic purposes, syllable and word level tasks, being easier, may also be more appropriate. The syllable level of each task could be administered and then using cutoff rules determined for each subtest, the examiner could decide whether to administer the word level or the phoneme level task. For the actual cutoff rules and a discussion of how they were determined see the longer report on the PRAI (Osborn, Hebard, Goldberg, 1978).

It is important to note that blending and segmenting skills, though related, do not always co- occur. When kindergartener's performance on component syllable and component phoneme segmenting was compared to their performance on syllable and phoneme blending, a number of children were observed who performed above the median on one task and below it on the other (36% at the syllable level and 28% at the phoneme level). Consequently, both skills must be evaluated; one skill can not substitute for the other especially in a diagnostic test.

Rhyming had a low though a significant correlation with achievement but it did not enter into any of the regression equations.

For this reason, it probably will not be useful for a predictive test. Furthermore, as segmentation was not required as part of the task it is not clear conceptually what relationship, if any, it should have with reading performance. For this reason, it probably will not be useful diagnostically either.

Initial sound association does correlate with first grade performance and does enter into the regression equations for quarter A. It may be useful for a predictive instrument. Its strong correlation with concurrently measured encoding suggests that it may be useful diagnostically as well.

Both subtests of the visual skills, matching and memory, correlated with first grade performance as individual subtests and entered into the regression equations for their respective quarters. In any diagnostic or predictive intsrument they need not both be used. For predictive purposes, visual memory may be better. For diagnostic purposes, visual matching may be a more clean test of children's visual discrimination, especially of orientation, as it would not involve the component of memory for orientation.

Encoding and decoding. Though both of these subtests correlated with first grade performance in reading equally well as individual subtests, when they were entered into a regression equation together decoding explained most of the variance and encoding contributed little. For that reason and also because encoding takes more administrative time, decoding would be more useful in a predictive test. It is possible that decoding and reading sight words would tap similar competancies. If this is so, then decoding could be eliminated, as the subtest of reading words is easier and faster to administer.

For diagnostic purposes, both encoding and decoding are important. Previous research has demonstrated that there are some beginning reader's

who find it easier to spell than to read and do so with greater accuracy (Goldberg, Hebard, Rozensher, 1978). The child's relative facility for encoding or decoding could be assessed as could the ability to learn from and apply letter sound instruction. Diagnostically, it is also important to compare the child's ability to segment and to blend auditorily with the use of these skills to assist in deocoding or encoding novel words.

Summary

In its present form, the PRAI represents one of the few attempts to combine the assessment of a variety of pre-reading competancies into a single individually administered diagnostic and predictive instrument. The high subtest reliabilities and the good multiple regression coefficients suggest that many of the subtests are suitable for their intended purposes. However, the instrument may be most useful if if is developed further into two separate tests, a short, predictive instrument and a longer diagnostic one. The subtests chosen for each instrument would be largely different but enough similarity could be maintained so that poor performance on the predictive test would signal the need for further diagnostic testing with the longer form. The quality of the current version of the PRAI warrants the additional test development.

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